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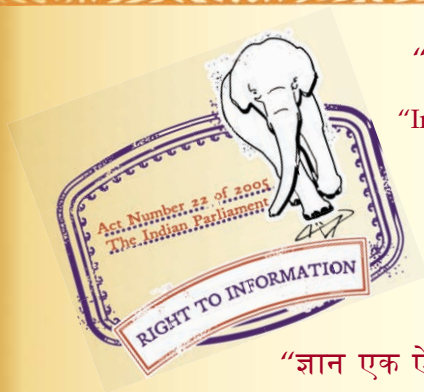
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“Step Out From the Old to the New”

IS 11782 (1986): Sodium Cyanide, Technical [CHD 1: Inorganic Chemicals]



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“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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Indian Standard
SPECIFICATION FOR
SODIUM CYANIDE, TECHNICAL

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Indian Standard

SPECIFICATION FOR SODIUM CYANIDE, TECHNICAL

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Indian Standard

SPECIFICATION FOR SODIUM CYANIDE, TECHNICAL

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 14 August 1986, after the draft finalized by the Inorganic Chemicals (Misc) Sectional Committee had been approved by the Chemical Division Council.

0.2 Sodium cyanide finds extensive use in the extraction of gold and silver from ores, in ore floatation process, pharmaceuticals and complexing agents, synthesis of intermediate compounds for preparation of hydrocyanic acid, heat treatment salts, preparation of metallic salts, etc.

0.3 This is also used as insecticides/weedicides; in the preparation of cyanuric chloride, cleaning of metals, as fumigant and in the manufacture of dyes and pigments and nylon intermediate.

0.4 The Institution has already published IS:6358-1971* and IS:9352-1980†.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS:2-1960‡. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard prescribes the requirements and methods of sampling and test for sodium cyanide, technical.

2. REQUIREMENTS

2.1 Description — The material shall be white crystalline solid in the form of powder, pellets or egg and shall be free from foreign matter.

*Specification for potassium and sodium cyanides for electroplating.

†Specification for sodium cyanide, pesticidal grade.

‡Rules for rounding off numerical values (*revised*).

2.2 The material shall comply with the requirements given in Table 1 when tested according to the methods prescribed in Appendix A. Reference to the relevant clauses of Appendix A is given in col 4 of the table.

TABLE 1 REQUIREMENTS FOR SODIUM CYANIDE, TECHNICAL

SL No.	CHARACTERISTIC	REQUIREMENT	METHOD OF TEST (REF TO CL NO. IN APPENDIX A)
(1)	(2)	(3)	(4)
i)	Sodium cyanide (as NaCN), percent by mass, <i>Min</i>	98.0	A-3
ii)	Sodium hydroxide + Sodium carbonate (as NaOH + Na ₂ CO ₃), percent by mass, <i>Max</i>	1.0	A-4
iii)	Sodium formate (as HCOONa), percent by mass, <i>Max</i>	0.5	A-5
iv)	Sodium chloride (as NaCl), percent by mass, <i>Max</i>	0.02	A-6
v)	Moisture, percent by mass, <i>Max</i>	0.20	A-7
vi)	Sulphides (as S), percent by mass, <i>Max</i>	0.005	A-8
vii)	Matter insoluble in water, percent by mass, <i>Max</i>	0.002 5	A-9

3. TOXICITY, SAFETY PRECAUTIONS IN HANDLING SODIUM CYANIDE, FIRST AID AND MEDICAL TREATMENT

3.1 Sodium cyanide is extremely poisonous and should be handled with extreme care. Useful information on this subject is given in Appendix B.

4. PACKING AND MARKING

4.1 Packing — The material shall be packed in air-tight resealable containers with an opening large enough to allow the contents to be easily removed.

4.2 Marking — The containers shall be marked legibly and indelibly with the following information:

- a) The name of the material and its net mass;
- b) Name of the manufacturer and recognized trade-mark, if any;
- c) Lot number, drum number and date of manufacture; and
- d) The word 'POISON' and the appropriate symbol [*see* IS:1260 (Part 1)-1973*].

4.2.1 The containers may also be marked with the Standard Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

5. SAMPLING

5.1 For general requirement of sampling the procedure given in IS:8883-1978† may be followed.

5.2 Scale of Sampling

5.2.1 Lot — All the containers in a single consignment drawn from a single batch of manufacture shall constitute a lot. If a consignment is declared or known to consist of different batches of processing, the batches shall be marked separately and the groups of containers in each batch shall constitute separate lots.

5.2.1.1 Tests for determining the conformity of the lot to the requirements of the specification shall be done on each lot separately.

5.3 The number of containers to be selected shall depend upon the size of the lot and shall be in accordance with Table 2.

5.3.1 The containers shall be selected from the lot at random and in order to ensure randomness of selection, the method given in IS:4905-1968‡ shall be followed.

*Pictorial markings for handling and labelling of goods: Part 1 Dangerous goods (*first revision*).

†Methods of sampling chemicals and chemical products.

‡Methods for random sampling.

TABLE 2 NUMBER OF CONTAINERS TO BE SELECTED

(Clause 5.3)

LOT SIZE	NUMBER OF CONTAINERS TO BE SELECTED
(1)	(2)
Up to 100	3
101 to 150	4
151 to 300	5
301 and above	7

5.4 Number of Tests

5.4.1 All the containers shall be visually checked for its material and whether it is free from foreign matter.

5.4.2 Tests for determination of all the characteristics given in Table 1 shall be conducted on composite sample.

5.5 Criteria for Conformity

5.5.1 From the tests results of sodium cyanide the average (\bar{X}) and range (R) shall be calculated,

where

$$\text{Average } (\bar{X}) = \frac{\text{Sum of the test results}}{\text{Number of tests}}$$

and Range (R) = Difference between the maximum and minimum of the test results

The lot shall be declared as conforming to the requirements of sodium cyanide if:

$$\bar{X} - 0.6 R \geq \text{the minimum value specified in Table 1}$$

5.5.2 The lot shall be declared as conforming to the requirements of the remaining characteristics of Table 1, if the composite sample meets the corresponding requirements of Table 1.

5.5.3 The lot shall be declared as conforming to the requirements of the specification if 5.5.1 and 5.5.2 are satisfied.

APPENDIX A

(Clause 2.2)

METHODS OF TEST FOR SODIUM CYANIDE, TECHNICAL

A-1. QUALITY OF REAGENTS

A-1.1 Unless specified otherwise, pure chemicals and distilled water (*see* IS:1070-1977*) shall be used in tests.

NOTE — 'Pure chemicals' shall mean chemicals that do not contain impurities which affect the results of analysis.

A-2. PREPARATION OF TEST SOLUTION

A-2.1 A stock solution is prepared by dissolving about 4 to 5 g of material in 250 ml water of previously boiled and cooled in a graduated flask containing no carbon dioxide.

A-3. DETERMINATION OF SODIUM CYANIDE CONTENT

A-3.0 General

A-3.1 Reagents

A-3.1.1 *Potassium Iodide Solution* — 10 percent (*m/v*).

A-3.1.2 *Standardized Silver Nitrate Solution* — 0.1 N approximately.

A-3.1.3 *Sodium Hydroxide Solution* — 5 percent (*m/v*).

A-3.1.4 *Dilute Ammonium Hydroxide* — 1:9.

A-3.2 Procedure — Weigh accurately about 5 g of the sample in a tared stoppered weighing bottle. Dissolve in water containing 10 ml of sodium hydroxide solution per litre, transfer to a 500-ml one-mark graduated flask, dilute to volume with the same water containing sodium hydroxide and mix.

A-3.2.1 Using a suction bulb (not suction by mouth), pipette 25 ml of the solution into a 500-ml beaker containing 300 ml of water and 3 ml of sodium hydroxide solution. Add 2 ml of potassium iodide solution and 5 ml of dilute ammonium hydroxide and titrate with silver nitrate solution with constant stirring against a black-background and transverse illumination to the first faint turbidity.

*Specification for water for general laboratory use (*second revision*).

A-3.3 Calculation

$$\text{Sodium cyanide (as NaCN), percent by mass} = \frac{196.06 \, VN}{M}$$

where

V = volume in ml of standardized silver nitrate solution required in titration,

N = normality of standard silver nitrate solution, and

M = mass in g of the sample taken for the test.

A-4. DETERMINATION OF SODIUM HYDROXIDE AND SODIUM CARBONATE CONTENT

A-4.0 General — This measurement is made by acid titration with hydrochloric acid after binding the cyanide as an $\text{Ag}(\text{CN})_2$ complex with silver nitrate solution.

A-4.1 Reagents

A-4.1.1 Standard Hydrochloric Acid Solution — 0.1 N.

A-4.1.2 Standard Silver Nitrate Solution — 0.1 N.

A-4.1.3 Barium Chloride Solution — 10 percent (m/v).

A-4.1.4 Phenolphthalein Indicator — 1 percent in alcohol.

A-4.2 Procedure — Take 25 ml of test solution (A-2) and add 15 ml of 0.1 N silver nitrate solution. Then add two drops of phenolphthalein indicator solution and mixture is titrated with 0.1 N hydrochloric acid until its colour changes to colourless. 25 ml of second test sample is again titrated with same amount of 0.1 N silver nitrate solution and add 5 ml of 10 percent solution of barium chloride and shake vigorously. Keep this solution to stand in the close flask for $\frac{1}{2}$ hour. After this time, 1-2 drops of phenolphthalein indicator is added and mixture is titrated with 0.1 N hydrochloric acid until its colour changes to colourless.

A-4.3 Calculation

$$\text{a) Sodium hydroxide (as NaOH), percent by mass} = \frac{0.4 \times V \times N}{M}$$

$$\text{b) Sodium carbonate (as Na}_2\text{CO}_3 \text{), percent by mass} = \frac{1.06 \times V \times N}{M}$$

where

V = volume in ml of hydrochloric acid used,

N = normality of hydrochloric acid, and

M = mass in g of the material present in the aliquot taken for the test.

A-5. DETERMINATION OF SODIUM FORMATE CONTENT

A-5.0 General — The formate content in sodium cyanide is determined by oxidimetric titration with potassium permanganate after precipitation of the cyanide with zinc sulphate solution.

A-5.1 Reagents

A-5.1.1 Zinc Sulphate Solution — 15 percent.

A-5.1.2 Standard Silver Nitrate Solution — 0.1 N.

A-5.1.3 Leibig-Deniges Indicator — Dissolve 44.1 g of sodium hydroxide, 3.6 g of potassium iodide and 180 ml of 25 percent ammonium hydroxide solution in water and dilute to one litre.

A-5.1.4 Standard Potassium Permanganate Solution — 0.1 N.

A-5.1.5 Standard Oxalic Acid Solution — 0.1 N.

A-5.2 Procedure — About 5 g of sodium cyanide is weighed accurately and dissolved in about 100 ml of water in 250 ml graduated flask. Add 100 ml of 15 percent zinc sulphate solution. The mixture is shaken vigorously and diluted with water up to 250 ml. The thoroughly mixed liquid is then filtered through dry finely pored filter paper No. 40. In order to check the precipitation of CN, 50 ml of the filtration is checked by 0.1 N silver nitrate solution for cyanide content until light opalescence prevails using Leibig-Deniges indicator. Same amount of 0.1 N silver nitrate is added in another 50 ml solution to precipitate remaining cyanide content. This mixture is then heated on water bath for a very short time. After it has cooled it is filtered through fine pored filter paper in another conical flask and filtrate residue is well washed out (at least 6 times). Depending upon the formate content expected 10-50 ml of 0.1 N potassium permanganate solution and 20 ml of about 25 percent sulphuric acid solution is added to the solution. The solution is then boiled briefly, and in the same hot condition a quantity of 0.1 N oxalic acid equivalent to 0.1 N potassium permanganate is added. The hot solution is then titrated with 0.1 N potassium permanganate solution until it develops a weak pink colour.

A-5.3 Calculation

$$\text{Sodium formate (as HCOONa), percent by mass} = \frac{0.34 \times V \times N}{M}$$

where

V = volume in ml of potassium permanganate used,

N = normality of potassium permanganate, and

M = mass in g of the sample taken for the test.

A-6. DETERMINATION OF CHLORIDE

A-6.0 General — The turbidity produced by the addition of silver nitrate solution to the solution of the material is compared with that produced in standard chloride solution.

A-6.1 Apparatus

A-6.1.1 Nessler Cylinders — 100 ml capacity.

A-6.2 Reagents

A-6.2.1 Hydrogen Cyanide Detection Paper — Paper as required by dipping strips of filter paper in a mixture of equal volumes of solution A and Solution B prepared as follows:

Solution A — *0.1 percent o-toluidine acetate* — Dissolve 0.64 g of o-toluidine in 5 ml of 50 percent (*m/v*) glacial acetic acid solution and dilute to 1 000 ml with water.

Solution B — *0.3 percent (*m/v*) copper acetate solution in water.*

A-6.2.2 Dilute Nitric Acid — 10 percent (*v/v*).

A-6.2.3 Standard Silver Nitrate Solution — approximately 0.5 N.

A-6.2.4 Standard Chloride Solution — Weigh accurately 0.165 0 g of sodium chloride (NaCl) and dissolve in water in 1 000 ml one-mark graduated flask and make up the volume. One millilitre of this solution is equivalent to 0.1 mg of chloride (as Cl).

A-6.3 Procedure — Weigh accurately 0.50 g of the sample, dissolve in 75 ml of water in a 150 ml beaker and place in an efficient fume chamber. Add 15 ml of dilute nitric acid cover with a watch glass and boil until hydrogen cyanide can no longer be detected (no blue coloration) with detection paper. Cool, rinse the watch glass, transfer the solution to the Nessler cylinder and dilute with water to the mark. Finally add 1 ml of silver nitrate solution and mix. Carry out a control test in another similar Nessler cylinder using 2.5 ml of the standard chloride solution and the same quantities of other reagents in the same total volume as with the material. Compare the turbidity produced in both the cylinders against a black background.

A-7. DETERMINATION OF MOISTURE

A-7.1 Procedure — Weigh accurately about 5 g of the material in a clean wide-mouth glass weighing bottle, previously dried and weighed. Place the weighing bottle in an oven maintained at $110^{\circ} \pm 2^{\circ}\text{C}$ for 3 hours. Cool in a desiccator and weigh with the lid on. Heat again for 30 minutes, cool and weigh. Repeat this process until the loss in mass between the successive weighings is less than 1 mg. Record the lowest mass obtained. Reserve the dried material for subsequent tests.

A-7.2 Calculation

$$\text{Moisture, percent by mass} = \frac{M_1 - M_2}{M_1 - M} \times 100$$

where

M_1 = mass in g of the weighing bottle with the sample before drying,

M_2 = mass in g of the weighing bottle with the sample after drying, and

M = mass in g of the empty weighing bottle.

A-8. DETERMINATION OF SULPHIDE CONTENT

A-8.0 General—The colour produced by the addition of alkaline lead acetate solution to the solution of material is compared with that produced in the standard sulphide content solution.

A-8.1 Apparatus

A-8.1.1 Nessler Cylinder—50 ml capacity.

A-8.2 Reagents

A-8.2.1 Alkaline Lead Acetate Solution—Dissolve 1.7 g of lead acetate and 35 g of sodium hydroxide in water and dilute to 100 ml.

A-8.2.2 Sodium Sulphide Solution A—Dissolve 0.75 g of sodium sulphide ($\text{Na}_2\text{SH}_2\text{O}$) in freshly boiled and cooled water and dilute to 1 000 ml. Pipette out 100 ml of this solution into 250 ml conical flask containing 10 ml of 0.1 N iodine solution and 25 ml of 0.1 N HCl. Back titrate with 0.1 N sodium thiosulphate solution adding 1 percent starch solution as indicator before the end point. Let the volume of 0.1 N iodine solution observed be a ml.

A-8.2.3 Sodium Sulphide Solution B—Fill a burette with sodium sulphide solution A and measure $100/1.6 a$ ml into a 1 000 ml graduated flask and dilute to volume with freshly boiled and cooled water. Prepare immediately before use. 1 ml of this solution is equal to 1 mg of sulphide (as S).

A-8.3 Procedure—Weigh out accurately and rapidly 0.4 g of sodium cyanide sample. Dissolve in 100 ml of freshly boiled and cooled water and fill to 50 ml Nessler cylinders with the solution. Add three drops of alkaline lead acetate solution to each of the cylinder and mix. Carry out a control test in a similar Nessler cylinder using known quantity of sodium

sulphide solution B in place of material alongwith the same quantity of alkaline lead acetate solution diluting to equal volume of sample solution. Compare the first solution with known volume of sodium sulphide standard solution and determine the value of sulphide content in sample after calculation.

A-9. DETERMINATION OF MATTER INSOLUBLE IN WATER

A-9.1 Procedure — Weigh accurately about 10 g of the material and dissolve it in 200 ml of water and boil for about 10 minutes. Filter the hot solution through previously dried and weighed sintered glass crucible No. G3 or asbestos padded Gooch crucible. Wash the crucible with hot water till the filtrate is free from alkali. Place the crucible in an oven maintained at $105 \pm 2^\circ\text{C}$ for 1 hour. Cool the crucible in a desiccator and weigh. Repeat the process of heating, cooling and weighing till constant mass is obtained.

A-9.2 Calculation

$$\text{Matter insoluble in water, percent by mass} = \frac{M_2 - M_1}{M} \times 100$$

where

M_2 = mass in g of the crucible after filtration,

M_1 = mass in g of the crucible before filtration, and

M = mass in g of the material taken for the test.

A P P E N D I X B

(Clause 3.1)

TOXICITY, SAFETY PRECAUTIONS IN HANDLING OF SODIUM CYANIDE, FIRST-AID AND MEDICAL TREATMENT

B-1. TOXICITY OF SODIUM CYANIDE

B-1.1 Sodium cyanide is very poisonous and acts very rapidly if it enters the body:

- a) as a result of swallowing solid or solutions, or
- b) by breathing cyanide dust, or
- c) by breathing hydrogen cyanide gas, or
- d) by absorption through the skin as a result of prolonged contact with strong solutions of sodium cyanide, or from splashes of molten cyanides.

B-1.2 Sodium cyanide is a Class A poison as defined in Poison Act, 1919.

B-1.2.1 In contact with acids and moisture, hydrogen cyanide is formed which is extremely poisonous when breathed. Prolonged contact of solid with the skin may cause irritation and caustic type burns. Sodium cyanide causes eye burns. It is good to remember that sodium cyanide releases hydrocyanic acid on contact with air and moisture.

B-2. SAFETY PRECAUTIONS NECESSARY FOR HANDLING OF SODIUM CYANIDE

B-2.1 Wear an approved anti-dust mask and respirator where there is a danger of cyanide dust or hydrogen cyanide gas because 100 to 200 ppm sodium cyanide and 300 ppm of hydrocyanic acid gas can cause a fatal accident.

B-2.2 Wear rubber or PVC gloves, rubber boots, aprons and approved chemical goggles or full face shield when handling sodium cyanide solutions or solid.

B-2.3 Store sodium cyanide in a dry well ventilated area. Do not leave containers open or permit access to sodium cyanide storage areas by unauthorized persons. Only trained competent persons should be allowed to handle sodium cyanide acidic salts.

B-2.4 Do not allow sodium cyanide to come into contact with acids or strong oxidizing agents.

B-2.5 Do not store, handle, consume food or beverages or smoke in areas where cyanide is being used, handled or stored.

B-2.5.1 Always wash hands before taking meals. If a worker suspects that cyanide has entered his mouth, he must carry out the procedure listed under First-Aid and send for a doctor.

B-2.6 The presence of hydrocyanic acid in the atmosphere can be detected in the following way. Strips of Whatman filter paper No. 1 are soaked in a solution containing 100 g anhydrous potassium carbonate and 10 g potassium chromate in one litre water. Surplus solution is removed and the paper allowed to dry. Immediately prior to making a test, apply a drop of a 5 percent (*m/m*) solution of *p*-nitrobenzaldehyde in diacetone alcohol to produce a spot of about 6 to 7 mm diameter. The test paper is then exposed for exactly 5 seconds in the atmosphere to be tested. A colour change to purple brown developing either as ring or covering the whole area after 5 seconds indicates that the atmosphere is dangerous containing a concentration of hydrocyanic acid greater than 10 ppm. Alternatively, the atmosphere can be tested using the Drager Normal-air hand pump and indicator tubes. It should be noted that individuals ability to detect hydrocyanic acid by smell varies widely and while some can detect small amounts readily, others are unable to detect dangerous concentrations.

B-2.7 Cyanide antidote should be kept near at hand in a convenient but safe location with instructions concerning first-aid treatment clearly displayed.

B-2.8 A card detailing the precautions to be observed when handling cyanide should be prominently posted in the store and in places of usage.

B-2.9 Tanks containing cyanide solutions should be clearly marked. The building in which they are positioned should be spacious, well ventilated and have satisfactory drainage and adequate washing facilities. The tanks should have the top edges three feet from ground level or adjoining platform or be railed off to that height. Fume exhaust ducting and equipment to the tank itself should be installed should hydrogen cyanide gas be liberated in high concentrations.

B-2.10 If an electric current is passed through a cyanide solution, it is essential to ensure adequate ventilation and absence of pockets in which evolved hydrogen can accumulate to form explosive mixtures with air or ignition by sparking.

B-2.11 Workers should be fully acquainted with the nature and hazards of the chemicals handled.

B-2.12 Sodium cyanide does not burn or suffer combustion when stored in original container and does not offer any fire hazard. But in case of fire due to other causes and container become perforated, hydrocyanic acid gas get liberated on contact with water. In case of flaming fire hydrocyanic acid will burn to harmless gas. High temperatures (560°C) will melt sodium cyanide and it will slightly explode. Water coming into contact with molten sodium cyanide will cause steam explosion.

B-3. SYMPTOMS OF CYANIDE POISONING

B-3.1 Following are the warning signs of cyanide poisoning.

B-3.1.1 Reddening of the eyes, dizziness, numbness, irritation of the throat, headache, rapid pulse, nausea, weakness of arms and legs.

B-3.1.2 More prolonged exposure can cause vomiting and laboured breathing followed by unconsciousness, rapid weak heart and death.

B-4. FIRST-AID AND MEDICAL TREATMENT

B-4.1 Speed is essential. A doctor must be notified at once. If solid or solutions of cyanide has been swallowed and the patient is conscious he must at once swallow one tumbler full of antidote consisting of equal parts of solution A and B.

Solution A — 158 g IP ferrous sulphate crystal ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) and 3 g IP citric acid crystals dissolved in one litre of cold water.

Solution B — 60 g anhydrous sodium carbonate (Na_2CO_3) dissolved in one litre of water.

The ferrous sulphate solution must be stored in dark bottles away from direct sunlight and must be renewed at least every 3 months. The sodium carbonate solution will keep indefinitely.

If the patient has inhaled hydrocyanic acid gas, he should be removed from the contaminated atmosphere. Rescuers must wear appropriate breathing equipment and protective clothing. It is important for the safety of rescuers that they continue to wear the appropriate safety equipment whilst carrying out the following instructions until the patient, the rescuers and the environment to which have been moved are all tested and declared free from sodium cyanide or hydrocyanic acid.

B-4.1.1 Contaminated clothing must be removed immediately and left in the open air disposed of safely.

B-4.1.2 Contaminated skin must be washed immediately using plenty of water. Where a shower is available contaminated clothing should be removed under the shower.

B-4.1.3 If breathing has stopped or shows signs of falling, apply artificial respiration immediately (do not use mouth to mouth method).

B-4.1.4 Allow the patient at the same time whilst recumbent to inhale pentyl nitrite (amyl nitrite). A capsule should be broken and held lightly in a handkerchief or gauze pad and held about an inch from the patient's mouth and nostrils for 15 to 30 seconds. Repeat every 2 to 3 minutes until the capsule is exhausted. A second capsule may be used.

B-4.1.5 Administer oxygen through a face mask.

B-4.1.6 If the patient is unconscious, do not give anything by mouth.

B-4.1.7 Keep patient at rest and arrange for him to be seen by a doctor as quickly as possible either on site or transferring him to hospital.

B-4.1.8 If the solid or liquid gas entered the eye it should be removed by irrigating for at least 10 minutes with eyewash solution or clean water. The patient should then be examined by a doctor for possible further treatment.

B-4.2 Medical Treatment

B-4.2.1 Notify a physician immediately. A suggested procedure for physicians or nurses is intravenous administration of 0.3 g (10 ml of a 3% solution) of sodium nitrite at the rate of 2.5-5 ml/min, followed by 12.5 g (50 ml of a 25% solution) of sodium thiosulphate at the same rate. Watch the patient for 24-48 h. If symptoms reappear, repeat the injections in half the original amounts. These solutions should be kept readily available. In some cases first-aid personnel have been trained to use the intravenous medication subject to government regulations.

B-4.2.2 Indications for Use of Antidotes — Cyanide act quickly and the value of a good history and clinical observation in diagnosis must be stressed. Symptoms of poisoning will appear within a short time of exposure to an acutely toxic dose of cyanide, irrespective of the route of exposure. The absence of such symptoms 30 minutes after exposure suggests that poisoning is unlikely.

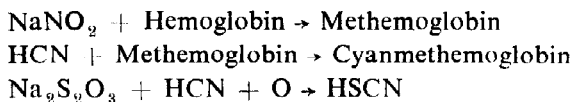
If, after consideration of the circumstances of the incident, it is accepted that the case is one of cyanide poisoning, the following broad principles should be followed.

B-4.2.2.1 If the patient is fully conscious, can talk clearly and has near normal pulse and breathing rate, the antidote need not be given unless the patient's condition deteriorates. Oxygen should be administered and the patient observed for at least one hour.

B-4.2.2.2 If the patient is deeply unconscious, specific treatment should be commenced at once.

B-4.2.2.3 There is an intermediate group of patients who are neither clearly conscious nor obviously unconscious. These exhibit a variety of signs consisting of a flushed appearance, mental confusion and verbal incoherence, fast and/or irregular pulse, fast and/or irregular breathing and a tendency to react violently or to start convulsions. In such cases, it is better to use at least one dose of the specific antidote and observe the results.

B-4.2.2.4 It should be noted that the signs and symptoms of acute anxiety and fear can be similar to that of cyanide poisoning. Sodium nitrate reacts with hemoglobin to form methemoglobin. The latter removes cyanide ions from various tissues and couples with them to become cyanmethemoglobin which has a relatively low toxicity. The function of sodium thiosulphate is to convert cyanide to thiocyanate, probably by an enzyme known as rhodanese. The combined mechanism may thus be expressed in a chemical manner:



The combination of sodium nitrite and sodium thiosulphate is the best therapy against cyanide and hydrocyanic acid poisoning. The two substances intravenously injected one after the other, namely, the nitrite followed by the thiosulphate are capable of detoxifying approximately 20 lethal doses of sodium cyanide in dogs and are effective even after respiration has stopped. As long as the heart is still beating, the chances of recovery by utilizing this method are very good.

There is not only a summation but also a definite potentiation of action when the nitrite and the thiosulphate are administered together.

(Continued from page 2)

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INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>	<i>Definition</i>
Force	newton	N	1 N = 1 kg. m/s ²
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m ²
Frequency	hertz	Hz	1 Hz = 1 c/s (s ⁻¹)
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m ²